On-farm Food Safety for Produce Growers

Microbial Water Quality Testing

Scott Monroe
Purdue Extension
Michael O'Donnell
Purdue Extension
Elizabeth Maynard
Purdue Horticulture & Landscape Architecture

The standard operating procedure (SOP) example on pages 6-8, was adapted from: E.A. Bihn, M.A. Schermann, A.L. Wszelaki, G.L. Wall, and S.K. Amundson. On-Farm Decision Tree Project: Agricultural Water for Production — v4. 2014, Cornell University. Available from the Cornell National Good Agricultural Practices Program website, www.gaps.cornell.edu.

Water quality is important, because the water you use on your produce farm could potentially introduce human pathogens into your production fields, equipment and workers, washing and packing facilities, and directly onto produce. To minimize the risk of introducing these pathogens, it is important to test the microbial quality of your water sources to ensure they meet safety criteria.

This publication is aimed specifically at produce growers. We will outline how the Food Safety Modernization Act (FSMA) Produce Rule applies to testing water sources, provide a sample water testing log for recordkeeping, and describe a standard operating procedure for water testing.

Even if you are not covered by the Produce Rule (that is, you are exempt), you should test your water regularly to be aware of potential problems with your water sources so you can act to correct them. Remember, good agricultural practices (GAPs) are all about reducing the risk of contaminating your produce.

Rules for Water Used on Growing Crops

The Produce Rule establishes specific thresholds for water that is applied to growing crops — in the form of irrigation, crop sprays, and so on. The U.S. Food and Drug Administration (FDA), which administers FSMA, lists key components of the Produce Rule at www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm. Even if your farming operation is exempt from FSMA requirements, the criteria provide good guidance.

To determine your legal water testing responsibilities under the Produce Rule, you must answer three questions:

1. Is My Farm Covered by the Produce Rule?

The first question you need to answer is whether you are required to follow the FSMA Produce Rule. The FDA created a flowchart to help you determine if your farm is covered. It's available at www.fda.gov/downloads/Food/GuidanceRegulation/FSMA/UCM472499.pdf.

2. Are My Crops Covered by the Produce Rule?

If a crop is seldom eaten raw (that is, it is normally cooked before consumption), then the crop is exempt from the Produce Rule. The FDA determines and lists crops exempt from the rule in the "Exemptions" section of the Produce Rule page at www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm.

3. Will I Apply Water to the Harvestable Part of the Crop?

This includes water that you apply as irrigation or crop sprays. The Produce Rule's water testing requirements apply only if water contacts the harvestable part of the crop.

If you answered yes to all three questions, then the FSMA Produce Rule (and its water testing requirements) applies to your particular farm and cropping practices.

Water Testing Is Critical

Regardless of whether the Produce Rule covers you, water testing remains a critical component of GAPs. Even if the Produce Rule does not cover you, test your groundwater (including water from wells) every year. If you use surface water for irrigation, you should test it at the beginning of the growing season and at least once more before harvest. We include a sample water testing protocol (page 6-8) to use as a guide for collecting water samples on your farm.

Interpreting Water Test Results

Always submit water samples to a certified lab. The Indiana State Department of Health maintains a list of certified water testing labs at www.in.gov/isdh/24859.htm.

Since water can be tested for many things, it is important to communicate with your lab to make sure they understand the specific test you require. If you're using water for irrigation, then you must ask the lab to test for generic *E. coli*. The Produce Rule specifies what testing method your lab should use. If you are covered by the Produce Rule (answered yes to all Questions 1, 2, and 3), be sure to communicate with your lab to ensure they can provide the required test.

Testing labs provide water test results as a number (or probable number) of colony-forming units (CFU) in a given volume of water — typically per

100 ml of water. For example, a water test result might report that a water source has 25 CFU generic *E. coli* per 100 ml of water. That sample would contain 25 generic *E. coli* in every 100 ml of the water sample.

If you are not covered by the Produce Rule, you should never use water from any source that exceeds 126 CFU generic *E. coli* per 100 ml, unless you take very specific steps to reduce risk. Contact your Purdue Extension county office for guidance.

If you are covered by the Produce Rule testing requirement, then you must perform an initial survey, which consists of several samples over a given period of time plus annual tests to continually document water quality.

When interpreting test results, the Produce Rule specifies a long-term geometric mean (GM) of ≤ 126 CFU generic *E. coli* per 100 ml of water and a statistical threshold value (STV) of ≤ 410 CFU generic *E. coli* per 100 ml of water.

Your Purdue Extension county office can locate people and resources to help you interpret water test results and compute the GM and STV of your water source. You can find your Purdue Extension county office at extension.purdue.edu/Pages/countyoffices.aspx. The University of Arizona Fresh Produce Safety website also offers a FSMA Produce Safety Rule Online Calculator at agwater.arizona.edu/onlinecalc.

Be aware that the testing requirements vary by water source. Table 1 summarizes the major points of the FSMA Produce Rule water testing requirements.

Rules for Water Used During or After Harvest

The Produce Rule also applies to water you use on produce or on surfaces that contact produce during or after harvest. This includes the water you use to clean contact surfaces, wash harvest tools, rinse produce, and wash hands. The FSMA Produce Rule prohibits any operator from using untreated surface water sources in harvest and postharvest operations. And the rule states that untreated ground water sources must have test results that show no detectable generic *E. coli* in 100 ml of water.

You must never use untreated surface water for postharvest operations — this applies whether you are covered by the Produce Rule or not. Furthermore, water used for postharvest operations should contain *no detectable* generic *E. coli* (that is, the water must be potable or of drinking water quality).

Remember: One bad water test will not put you out of business. A bad test simply points out another risk factor that you must manage. If your water test result shows elevated *E. coli* levels, contact your Purdue Extension county office. They can connect you to the appropriate people and resources for guidance.

Table 1 summarizes the FSMA Produce Rule's water testing requirements for various water sources. The table provides what the rule requires for the initial (baseline) survey, what water tests each water source requires annually, and the criteria for coverage.

Table 1. Water testing requirements for farms covered by the FSMA Produce Rule.

Source	Initial (Baseline) Survey	Annual Testing Requirement	Coverage Criteria	Understanding Water Quality Test Results
Public water system	None	None	Crop is covered by the FSMA Produce Rule (that is, you answered "yes" to Question 2 on page 2) You apply water to the harvestable portion of the crop or food contact surfaces (that is, you answered "yes" to Question 3 on page 2).	No testing required for these water sources. Each year, request and keep records from your water utility that show the water source meets U.S. Environmental Protection Agency (EPA) drinking water standards.
Untreated ground water (including well water)	4 samples during the growing season or within 1 year.	One water test per year. Preharvest uses: These samples contribute to a rolling 4-year data set for calculating GM and STV. Postharvest uses: These samples verify that there continues to be no detectable *E. coli* in 100 ml of water.	Crop is covered by the FSMA Produce Rule (that is, you answered "yes" to Question 2 on page 2) You apply water to the harvestable portion of the crop or food contact surfaces (that is, you answered "yes" to Question 3 on page 2).	Preharvest Use: If annual testing shows GM or STV greater than the criteria (126 and 410 CFU generic *E. coli* per 100 ml water respectively), you must take corrective action within 1 year to continue using the water source. You may need to re-establish an initial survey with 4 samples. Postharvest Use: If a water test shows any generic *E. coli* in 100 ml water, immediately discontinue use. You must take corrective action and you must revert to sampling the water source 4 times per year. You can resume using the water source when test results detect no generic *E. coli* detected in 100 ml of water.
Untreated surface water	20 samples within a 2- to 4-year period.	5 samples during the growing season or within 1 year. These samples contribute to a rolling 4-year data set for calculating GM and STV.	Crop is covered by the FSMA Produce Rule (that is, you answered "yes" to Question 2 on page 2) You apply water to the harvestable portion of the crop or food contact surfaces (that is, you answered "yes" to Question 3 on page 2).	Preharvest Use: If annual testing shows GM or STV greater than the criteria, you must take corrective action within 1 year to continue using the water source. You may need to re-establish an initial survey with 20 samples. Postharvest Use: The rule prohibits using any untreated surface water.
Treated water	None	None	Crop is covered by the FSMA Produce Rule (that is, you answered "yes" to Question 2 on page 2) You apply water to the harvestable portion of the crop or food contact surfaces (that is, you answered "yes" to Question 3 on page 2).	No testing required, but the treatment must be effective to make the water safe. In addition, the water must be of adequate sanitary quality for its intended use and/or meet the relevant microbial quality criteria. Preharvest Use: Water must not exceed the GM and STV thresholds. Postharvest Use: Test results must show no detectable generic *E. coli* in 100 ml of water.

Water Testing Result Log

This is an example of a recordkeeping log you can use to document water test results. You may adapt this log for use on your farm, and for your On-farm Food Safety Plan.

Save all documents that provide information about test methods and test results from your laboratory.

Sample Date	Water Source (Type/ Location/Name)	Laboratory	Type of Test Performed	Lab Report Date	Results	Corrective Actions (if necessary)	Initial

Sample Standard Operating Procedure for Water Testing

A standard operating procedure (SOP) is a document that specifies how you should perform a particular task. This section is an example of an SOP for sampling water.

Produce growers who have obtained (or are working toward obtaining) a third-party GAPs certification must have a written on-farm food safety plan. You can include your water-testing SOP in your on-farm food safety plan. This example provides instructions about proper water sampling techniques, and was adapted from *On-Farm Decision Tree Project: Agricultural Water for Production* — v4 (E.A. Bihn, M.A. Schermann, A.L. Wszelaki, G.L. Wall, and S.K. Amundson, 2014, Cornell University). This publication is available from the Cornell National Good Agricultural Practices Program website, www.gaps.cornell.edu.

Even if you don't plan to obtain a third-party GAPs certification, this SOP provides a useful "standardized" framework for collecting water samples.

1 — Purpose

This document describes how to sample surface water for generic *E. coli* analysis. You can also use this document for sampling well, surface, or postharvest water.

2 — Scope

This SOP applies to any farm personnel responsible for sampling water and submitting it to a laboratory for analysis.

3 — Responsibility

Anyone who is responsible for sampling water or submitting water samples to a laboratory should understand this SOP. Anyone who is responsible for keeping records of water tests results should also be familiar with this SOP in case there are unusual test results.

4 — Materials

Any person who will collect or submit a water sample will need the following materials:

• A marker for labeling the sampling container

• A water sampling stick (not required but helpful for sampling surface water)

• Disposable gloves

• A sealed, sterile sampling container (a 1-liter bottle or a container provided by the lab)

• A cooler

• Ice packs — you can use bags of ice or frozen packs, just be sure they can keep the sample cold

• Packing tape to securely seal the shipping container

• Gallon-size zipper-seal bags (one for each collected sample plus one for paperwork)

• Garbage/disposal bag for waste

• Shipping labels (if mailing to lab)

5 — Procedure

You should always follow the instructions that your water testing lab provides about the container and sampling protocol.

Water Sampling Protocol for Surface Water

When drawing a water sample from surface water, follow these steps:

1. Label container with the name of the person collecting the sample, water source, date, and collection time.

2. Identify a good sampling area — sample as close to water use point as possible.

3. If using a sampling stick, assemble bottle on sampling stick.

4. Put on gloves.

5. Open the collection container as close to the sampling area as possible. Do not place your fingers on the container lip or inside the container.

6. Dip the sampling container into the source and collect water. If you are sampling from irrigation equipment, let the water run for a minimum of 5 minutes to ensure you are getting water that has not been sitting in the pipes. Do not let the container lip contact irrigation equipment. Collect at least 100 ml of water from each location. Sample the water after it flows through the irrigation filter (if applicable).

7. When the container is full, seal the container. Do not touch the inside or lip of the container.

8. Double-check the container label to be sure it is correct.

9. Place the sample in a 1-gallon zipper-seal bag and seal (only critical if shipping samples).

10. Place bagged sample in the cooler filled with ice packs.

11. If shipping the samples, label and seal the cooler and seal. If the laboratory requires any paperwork, seal the paperwork in a zipper bag and place it in the cooler before sealing.

12. Deliver the cooler to the lab or drop off at shipping company. Be sure delivery meets the hold-time requirement set by the laboratory and the analysis method; otherwise, test results may not be accepted by the buyer, auditor, or regulatory agency.

Water Sampling Protocol for Well Water (may also be used for postharvest water)

When drawing a water sample from a well (or for postharvest water), follow these steps:

1. Label the sampling container with the name of the sampler, water source, date, and collection time.

2. Identify a good sampling area — sample as close to water use point as possible.

3. Turn on the faucet and let the water run long enough so that you are testing water from the well and not just the water that has been sitting in the pipes or hose. Depending on your water system, this could be as long as 10 minutes or as short as 1 minute. If you know the volume of your system and flow rate, allow 2-3 times the volume of the system to evacuate prior to sampling.

4. Put on gloves.

5. Open the sampling container as close to the point of use as possible. Do not place your fingers on the container lip or inside the container.

6. Place the sampling container into the running water and collect at least 100 ml of water. Leaving a little head space makes it easier for the laboratory to mix and pour the sample once it arrives.

7. When the container is full, seal the container. Do not to touch the inside or lip of the container.

8. Double-check the container label to be sure it is correct.

9. Place the sample in a 1-gallon zipper-seal bag and seal (only critical if shipping samples).

10. Place bagged sample in the cooler filled with ice packs.

11. If shipping the samples, label and seal the cooler and seal. If the laboratory requires any paperwork, seal the paperwork in a zipper bag and place it in the cooler before sealing.

12. Deliver the cooler to the lab or drop off at shipping company. Be sure delivery meets the hold-time requirement set by the laboratory and the analysis method; otherwise, test results may not be accepted by the buyer, auditor, or regulatory agency.

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